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A SELF-MIXING DUSTING MACHINE FOR APPLYING DRY INSECTICIDES AND FUNGICIDES

BY
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A SELF-MIXING DUSTING MACHINE FOR APPLYING DRY INSECTICIDES AND FUNGICIDES

BY

RALPH E. SMITH AND JOSEPH P. MARTIN

The use of nicotine dust as an insecticide, which was described by the senior writer in Bulletin 336 of this station, has aroused much interest all over the United States. The advantages of the quick and easy application to be secured by this method are of value in the control of a number of insects which are in general not being handled satisfactorily by the liquid spray method. Among the California species of such insects may be mentioned the walnut aphis, pea aphis, melon aphis, prune thrips, and citrus thrips. The use of the nicotine dusting method has, however, at present, some drawbacks which, in the writer's opinion, must be largely remedied before it can become a complete success. The difficulties are connected with the manufacture, distribution, and use of nicotine dust on a commercial scale, as opposed to limited or experimental work. Several companies, in various parts of the country, are at present putting nicotine dusts upon the market, but, as a rule, with only partial success from the standpoint of either themselves or their customers. The usual method of manufacture consists in mixing the desired amount of nicotine (usually in the form of nicotine sulfate solution) with lime, clay, gypsum, or some other inert carrier; then pulverizing and working the product in various ways to make it fine, dry, and uniform. Other materials, like sulfur and lead arsenate, are added if desired. The finished product is packed in air-tight steel drums or cans to prevent loss of nicotine by volatilization.

There are three serious disadvantages in this method when it is used on a large scale. 1. The cost of the material to the consumer is excessive. This must be the case, when products that are composed almost entirely of inert, low grade "filler" are subjected to manufacturing costs plus several profits, packed in expensive containers, and shipped and sold on the same basis as high grade insecticides. The average nicotine dust contains about 98 per cent of inert material, of no value except as a carrier of the nicotine. In a liquid spray this is replaced by the water, which costs nothing. Material like hydrated

lime, suitable for the carrier in the dust can be purchased almost anywhere at a price of between one and two cents a pound. Since, however, the consumer must at present buy his nicotine dust ready mixed at a factory, he pays many times this amount for the carrier. This difficulty is not as serious where the material is used on a rather small scale, but in the extensive, general use of nicotine dust the unavoidably high cost is a very serious drawback. 2. The amount of nicotine in most of the mixtures which have thus far appeared on the market has been extremely uncertain and variable, and often below the amount calculated, no matter how honest the intentions of the manufacturer. This fact is probably due to the volatile nature of nicotine, which causes constant losses during mixing and subsequent storage. 3. Nicotine in dust form has a very low efficiency in proportion to that of the same amount in liquid form. This is especially true at low temperatures, and is due to slow volatilization. For this reason, the more resistant insects require dust containing excessive amounts of nicotine, most of which is wasted. This waste causes prohibitive expense when the use of nicotine dust against such insects is attempted on a large scale.

The manufacture of nicotine dust was originally carried on by the California Walnut Growers' Association for its own members, at cost. Various facilities which had to be maintained in any event for other purposes were utilized, thus keeping down the overhead expense. The material, after being mixed in a rather crude way, was packed in cheap containers and hauled out in trucks by the consumers themselves for immediate use in nearby orchards. This method was cheap and effective. The commercial manufacture and distribution of nicotine dust for general use, on the other hand, has proved to be a far different matter. It should not, however, be inferred that this work has been a failure. On the contrary, there has been produced and sold much material which has given good results in the control of various insects. Methods of manufacture have lately been improved so that the nicotine dusts now on the market are, in general, better and cheaper than the earlier products. For use on a rather small scale especially, or where expense is not a limiting factor, satisfactory commercial dusts are now available. The great drawback lies in the fact that in numerous cases where nicotine dusting has peculiar advantages in the control of serious insect pests, the use of this method is prevented, or seriously handicapped, by the high cost of the material.

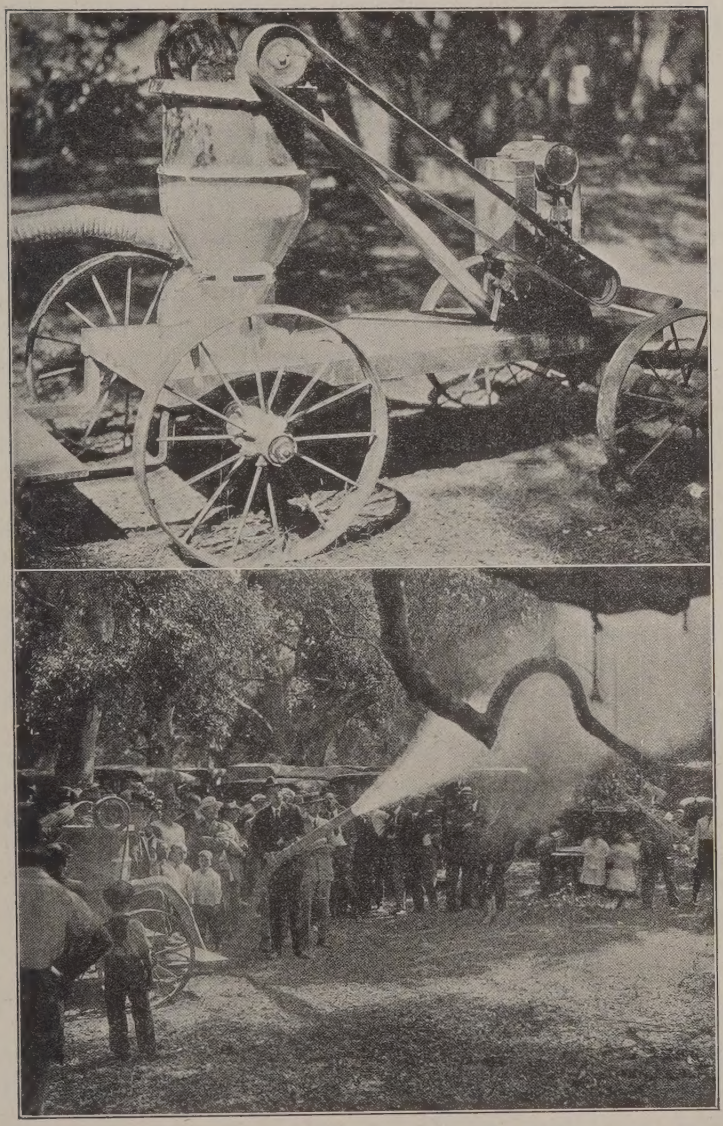

Fig. 1.—Demonstration of self-mixing duster at Walnut Growers' Field Day, Goleta, California, September 2, 1922.

Bulletin 336, under the discussion of "How May Nicotine Dust Be Improved and Cheapened," contains the following paragraph:

"SUGGESTION OF A NEW TYPE OF DUSTING MACHINE"

"In conjunction with Mr. W. W. Thomas the writer has developed somewhat the idea of a combined dusting and mixing machine, the plan being to place the raw materials in the machine in the field and do the mixing in the hopper of the dusting machine, just as is done in the tank of a liquid sprayer. Such a machine, if feasible, would have the following advantages: The grower could buy materials like 'Black Leaf 40,'* hydrated lime and sulphur almost as cheaply as the present dust manufacturers and save the expense of mixing, containers, 'overhead,' several profits, and much of the freight. He could vary the strength of the mixture according to his needs. Little or no nicotine would be lost in the process of mixing and handling. The first full strength of the nicotine and ammonia when set free from 'Black Leaf 40,'* by lime would be utilized. By adding a small amount of quick-lime, or other material, heat could be developed in the mixture and the dust discharged in such a hot condition that the nicotine would be very volatile and active, and a smaller amount of 'Black Leaf 40'* would therefore be required. This is perhaps the greatest advantage of all in the use of this method.

"The idea of the machine which we have had in mind contemplates a hopper containing a mixing screw, into which finely pulverized and liquid materials would be placed in the proper proportions. Hydrated lime would be the most generally available filler material, with 'Black Leaf 40'* as a source of nicotine. Pulverized quick lime or 'Dry Lime Sulphur' could be added if necessary for drying, or for producing heat. From the hopper, after brief mixing, the material would be drawn through the fan (using an exhauster) rather than blowing it out ahead of the fan as in the present machines. The action of the fan would complete the mixing and break up the nicotine lumps. This would, of course, be a power machine; for hand use, ready-made mixtures would still be required."

CONSTRUCTION OF THE SELF-MIXING DUSTER

In the furtherance of this idea a machine which thus far has been entirely satisfactory was developed in 1922. The point was, as suggested in the quotation above, to place in the hopper a fairly high speed agitator for a preliminary mixing, then to break up the lumps by passing the material through the fan. The latter principle was found already embodied in the power duster put

* When this was written "Black Leaf 40" was practically the only nicotine sulfate on the market. Several other brands of equal nicotine content are now available.

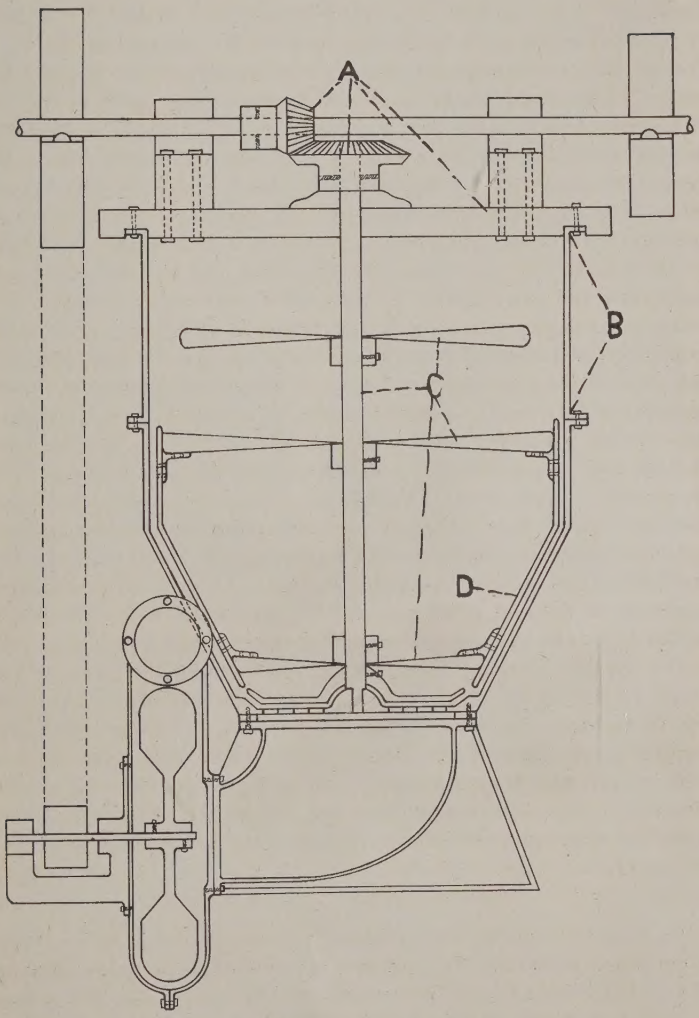

Fig. 2.—Vertical section drawing of self-mixing duster. *A*, drive shaft, gears and top. *B*, iron collar added to increase capacity of hopper. *C*, agitator shaft and blades. *D*, scraper.

on the market in 1922 by the Dosch Chemical Company of Louisville, Kentucky. The machine illustrated in figures 1, 2, and 3 was built by remodeling one of these dusters, lent for the purpose by Mr. F. A. Frazier of San Francisco, western representative of the Dosch Company. The changes made in the original machine were as follows: The height and capacity of the hopper were increased by means of the ten-inch black iron ring or collar forming the upper part of the hopper as shown in the illustrations (fig. 2 B). The original lid, drive-shaft, and gears were discarded. A wooden lid was fitted to the top and a drive-shaft with pulleys mounted as it is shown (fig. 2 A). A vertical shaft in the center of the hopper was driven by means of gears from the cross shaft. To this center shaft were attached horizontal arms made of two by one-fourth inch iron, sharpened on the front edge and slightly turned up on the ends, extending almost to the sides of the hopper, (fig. 2 C). There are three sets of blades, comprising four each. Vertical blades or scrapers were attached to the ends of two of the arms in the middle and lower set (fig. 2 D). This formed the agitator. The feeding device in the bottom of the hopper was not changed. The various pulleys and gears are of such sizes as to give a speed of 120 revolutions per minute in the agitator, and 3000 revolutions per minute in the fan. Nothing about the arrangement, shape, or style of this particular machine is to be looked upon as a finished product or as a model for permanent use. The fundamental idea is to have a machine with a fairly rapid, efficient agitator in the hopper, and one in which the dust passes through the fan. No patent rights are involved in securing these essentials. As to the rest of the machine, it is not at all necessary to use any exclusive features of the Dosch or any other duster. The contrivance we have pictured is simply a crude device, built in the easiest possible manner compatible with carrying out the idea involved. A machine could easily be designed to work either with factory-mixed dust or as a self-mixer.

HOW THE SELF-MIXER WORKS

In making nicotine dust with such a machine, a sack (100 pounds) of hydrated lime is first dumped into the hopper. The desired amount of nicotine solution (usually from one to five pounds) is then poured in onto the lime, the lid is closed and the machine started. When the machine was first used, it was thought that it would be necessary to run the agitator five or ten minutes before starting to dust, but this proved to be unnecessary. With the agitator running at 120 revolutions per minute, only a few seconds are required to mix the mass

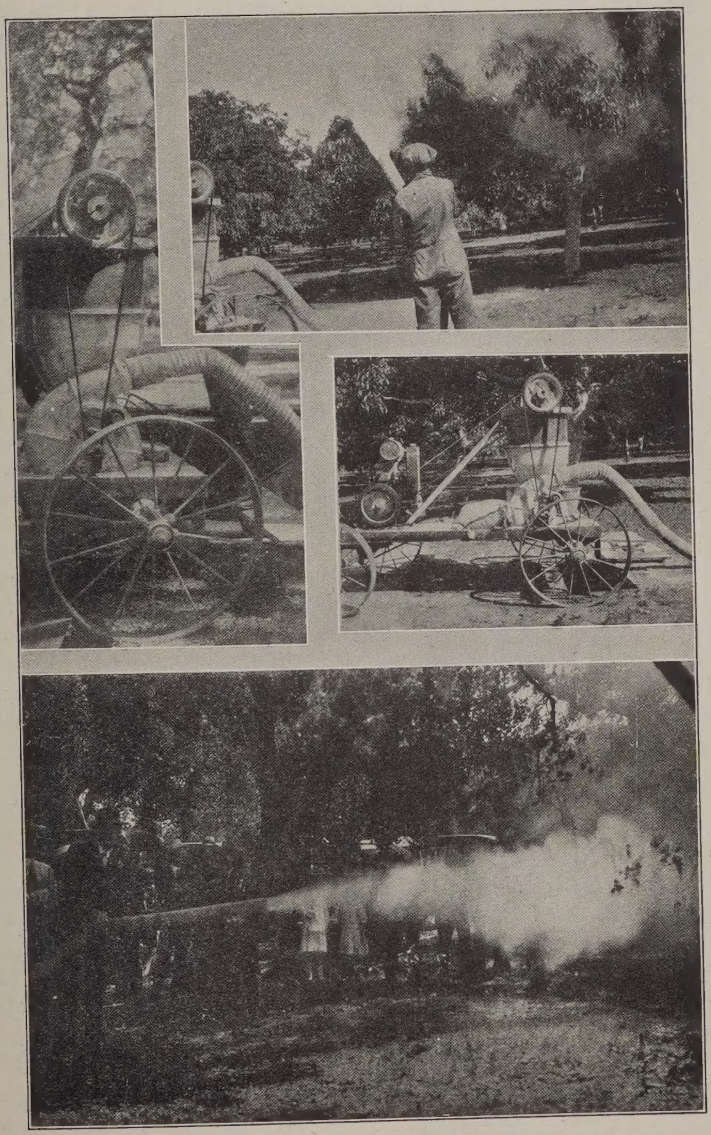

Fig. 3.—Dusting walnut trees with self-mixing duster.

thoroughly enough so that it feeds down into the fan in the right proportion. Hydrated lime is mentioned because it is cheap, finely pulverized, and easily available.

POWER REQUIRED

The machine was run with a four horse-power Cushman engine, which gave ample power.

MAKING DRY MIXTURES

In tree dusting it is often desirable to mix sulfur, lead arsenate, dehydrated copper sulfate, and other powders with lime or with each other. Such mixing is quickly, thoroughly, and cheaply accomplished with this type of machine, and may be done in any desired proportion. Nicotine solution may also be added to these materials.

ADDITION OF MATERIALS TO HEAT THE DUST

All experience has shown that the action of nicotine dust is one of fumigation and that it is therefore desirable to make the nicotine just as volatile as possible. This is largely effected by temperature. By mixing with the nicotine dust five to ten per cent of pulverized quick lime, dry lime sulfur (calcium polysulfide), soluble sulfur (sodium polysulfide), or other caustic materials, heat may be produced and the effectiveness of the nicotine thus increased. The sulfides have also some insecticidal effect in themselves. The further addition of a little kerosene adds to the effect. The pulverized quick lime for this purpose must be specially prepared but the other materials mentioned are available in many places.

SAVING IN COST AND OTHER ADVANTAGES OF THE SELF-MIXER

The financial saving effected by such a machine is self-evident. With nicotine sulfate solution at $1.20 a pound and hydrated lime at 1 cent a pound, a 1½ per cent dust, such as that used for walnut aphis would cost 3 cents a pound, while a 5 per cent dust would cost 7 cents. This is less than half the usual f.o.b. price of similar factory-made mixtures. The saving in cost would be less important if the ready-mixed dust were in any way superior to the machine-mixed variety, but exactly the opposite is true.

The advantages of the self-mixer may be again enumerated as: 1. No expense, save that of the raw materials. 2. No loss of nicotine. 3. No carrying over of mixtures and consequent deterioration after the season has ended. 4. Possibility of applying dust hot. 5. Possibility of making mixtures in any desired proportions.

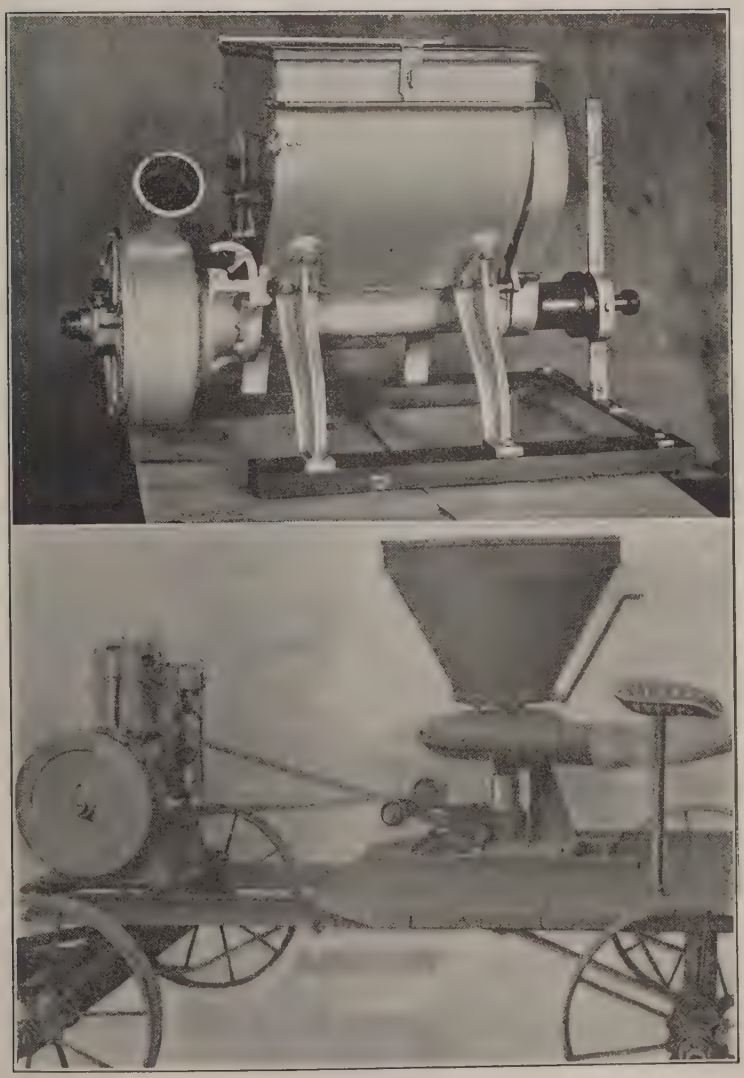

Fig. 4.—Two self-mixing dusters which are now on the market. Above, machine made by Smith Manufacturing Co., San Jose, Cal. Below, Bean Spray Pump Co., San Jose, California.

LIMITATIONS OF THE SELF-MIXER

It should not be thought that the use of this machine will entirely take the place of the use of factory-mixed dust. The idea, at present, applies only to a large power machine and is impracticable where hand machines are employed, or in any small scale work. Furthermore, many growers prefer ready-made material to anything which requires accurate measurement and mixing of materials in the field. The self-mixing machine, by increasing the practice of dusting, promises to supplement and extend the use of ready-made mixtures rather than to supplant or lessen their use.

SELF-MIXING DUSTERS IN 1923

This division has coöperated with the Smith Manufacturing Company and the Bean Spray Pump Company, both of San Jose, California, in the development of the self-mixing dusters shown in figure 4. Mr. A. P. Craig of Morgan Hill, California, originally devised both of these machines for ordinary dusters, while Mr. W. W. Thomas formerly of this division, did much of the work of converting them into self-mixers.

FREE NICOTINE USED INSTEAD OF NICOTINE SULFATE

Experience is showing that a dust made with free nicotine is more powerful, unit for unit, than one in which nicotine sulfate is used. The free nicotine solution also mixes and spreads through the carrier better than the sulfate, as it contains less solids and gummy material. A very good nicotine dust for home garden use can be made by simply stirring up together five pounds of sulfur and ¼ pound of 40 per cent free nicotine solution, several brands of which are in the market. This mixture is improved by standing for a day or two in an air-tight can.

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